

SCROTAL ASYMMETRY AND HANDEDNESS

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INTRODUCTION

The asymmetry of the human scrotum is an intriguing morphological phenomenon, for which diverse views and explanations have been presented. Current standard English text-books of human anatomy (Gray, Cunningham, Morris) describe the left side of the scrotum as descending lower than the right to correspond with the lower position of the left testis or with the longer spermatic cord. This statement is only partially true, for while testicular position and scrotal form are certainly correlated, the left side of the scrotum is not always the lower. Furthermore, the statement is ambiguous in that it is sometimes assumed to be based on an embryological explanation, i.e. that the left testis descends in advance of the right, or that the left spermatic cord is longer because of the association of the left testis with the more cranially situated left kidney. For these claims we can find no substantiation in standard embryological treatises.

Poirier & Charpy (1923) state that the testes of infants at the time of birth are situated at the same level in the scrotum, but later the left testis becomes lower than the right. They go on to say (and we give a translation of their account): 'One admits in general with Wincklemann (an observation well shown by sculptors before him) that the left testis is situated usually $\frac{1}{4}$ –1 cm. lower than the right. Some anatomists, Charpy, for example, contend this view. One may rightly ask why the testes, which are situated at the same level in infants, should occupy unequal levels in the adult? One might wish to explain the lower descent of the left testis as due to a congenital inferiority of the left side. It would be equally wrong to assume that this lower position is due to the heavier weight of the left testis, a fact which has not been demonstrated. It appears that, with Poirier, one should ascribe the cause to the very position of these glands in the angular interval between the thighs after leaving the neighbourhood of the pubis. Situated in this space, the testes, overlapping and pressing on each other, would adapt themselves by gradually modifying their positions. Suspended by the spermatic cords, the testes are mobile in all directions which permit them to escape shocks; they ascend towards the external inguinal ring by the contraction of the cremaster, and descend by their weight.' This teleological account, however, leaves unanswered the question why it is that the left testis is generally lower. If it were merely a matter of adaptation of the testes to the limited wedge-shaped space between the thighs, then the chances of either testis to occupy a higher or lower position would be theoretically about equal.

Braus (edited by Elze, 1956) approaches the problem from an entirely different angle, that of the venous drainage of the testes by the spermatic veins, i.e. the right vein joining the inferior vena cava at an acute angle and the left joining the left renal vein at right angles, with the accompanying disadvantage of increasing the

resistance to the venous return from the left side. He states that on account of this increased resistance and a consequent vascular stasis in the tributaries of the left spermatic vein, the left testis is heavier and normally hangs slightly lower than the right. According to our findings to be stated later, the right testis is in fact generally heavier and bulkier than the left.

MATERIAL AND METHODS

(1) *The subjects and observation of the scrotum.* The subjects for examination were all Chinese, drawn from three unselected groups, namely (1) hospital orderlies (95), (2) general out-patients (304) and (3) students of Hong Kong Sea School (87), totalling 486. The ages of these subjects ranged from 14 to 64, and the distribution is shown in Table 1, with the number of subjects arranged under the columns of right- and left-handers. Subjects having abnormalities of any kind in the scrotum such as hydrocoele, pathological conditions of the testis or epididymis, agenesis of testis or any sign of dermatitis of the scrotal skin, were excluded. The examinations of the first two groups were performed during the hot summer months, and those of the last group in the autumn with the room temperature of 70–75° F. They were unaware of the reason for the examinations, accepting them as part of a routine 'check-up' in health.

Table 1. *Subjects examined (486)*

Age	Number of subjects	
	Right-handers	Left-handers
14	22	—
15	13	2
16	18	2
17	15	—
18	21	1
19	4	1
20–24	62	10
25–29	71	6
30–34	72	8
35–39	51	—
40–44	43	3
45–49	26	—
50–54	17	1
55–59	10	—
60–64	6	1
Total	451	35

To ensure as complete relaxation as possible, each subject was engaged in informal conversation throughout the examination. He was asked to stand facing the observer with his feet 18 in. apart, and a spirit level ruler, marked with a millimetre scale and adjustable in height and level, was placed standing below the scrotum to serve as a gauge for measuring the relative level of the two sides of each subject. The levels were noted on a card, together with the name and age of each subject. To test the effect of exertion on the position of the testes and of the scrotum, a weight (25 lb. for subjects older than 20, and 10 lb. for subjects younger than 20) was passed to his right hand first, to be lifted vertically close to the right side of the body. The weight was then transferred after a short interval to the left hand and lifted on that side; this order was maintained throughout the tests of all the subjects and the

effects on scrotal levels were, in each case, recorded on the card. In many cases these tests were repeated and the contraction of the abdominal muscles demonstrated by palpation. Photographic records were made of the scrotum in all the stages of the examination.

Only simple tests for handedness were made, which consisted of throwing, reaching and kicking three times in different order. Though crude, they provided adequate evidence of functional dominance for our present purpose. Preference of the hand and foot used in these tests, and questioning the subjects on their preference in other activities were taken as criteria of handedness.

(2) *The weight, volume and position of the testes.* The scrota of 100 cadavers were examined in the mortuary, a record was kept of the age and the relative level of the two sides of the scrotum, and a compass measurement was made of the distance from the lower pole of each testis to the mid-point of the pubic arch. The tunica vaginalis was shelled out of the scrotal sac and removed with the spermatic cord and labelled. A slit was made in each tunica to see the upper border of the epididymis, at which level the tunica and the spermatic cord were cut across, and the post-mortem exudate, if any, evacuated. The tunica with its contents and the associated portion of the spermatic cord were weighed together. Finally, each testis was dissected free of the tunica, epididymis and other extraneous tissue and weighed. The greatest circumference of the right and left forearms was measured as indication of handedness. Specimens showing abnormal or diseased conditions were excluded.

OBSERVATIONS

(1) *Relative level of the two sides of the scrotum in living subjects.* The subjects numbered 486, of whom 35 were left-handed. The percentage difference in the relative level of the two sides of the scrotum is opposite in the right- and left-handers, the right-handers having the right side higher in 64·7 %, and the left-handers having the left side higher in 68·5 % of cases. The exertion tests definitely affected the position of the testes by raising them, and the characteristics of the effects can be divided generally into two categories: (1) In the majority of cases the effect was seen to be more on the testis of the same side and relatively less, though present, on the testis of the opposite side but on the whole not to the extent of altering the relative level seen before testing, except in fourteen cases. In these latter cases the original relative level was altered depending on the side exerted, that is to say, when the right side was exerted, the right testis went up to a relatively higher level than the left and vice versa. (2) In a minority of cases the effect of exertion was on the testis of the opposite side. In twenty-three cases, right and left exertions raised the testis of the opposite side higher than the original level before exertion, and in ten cases the position of the testis was variable depending on the side exerted, i.e. when the right was exerted, the left testis went up higher than the right testis and vice versa when the left was exerted.

The χ^2 test ($P = < 0.01$) shows a significant correlation between scrotal asymmetry and handedness (both without and with exertion). Our findings are at variance with those of Antliff & Shampo (1959).

(2) *The relative position, weight and volume of the right and left testes obtained from cadavers in the mortuary.* Although measurements of the forearms were taken and

by these measurements five of the cadavers were assumed to be definitely left-handers, a few were borderline cases about which we could not be certain. It has been considered best, therefore, to consider all the cases together without regard to handedness. The right testis was found to be higher in 65 % of cases, the left testis higher in 33 %, and both testes occupying the same level in 2 % of cases. Table 2 gives our data of the relation of the weight of the testes to their position. Table 3 gives the mean weight of the right and left testes with and without adnexa (i.e. tunica vaginalis, epididymis and the associated part of the spermatic cord), mean volume, mean difference and probability.

Table 2. *Relation of testicular weight to position in cadavers*

	Incidence of occurrence	
	Right testes	Left testes
Testes higher and heavier	42	5
Testes lower and heavier	27	20
Testes heavier and occupy same level	2	0
Testes of same weight but higher on one side	3	1
Testes higher and lighter	20	27
Testes lower and lighter	5	42
Testes lighter and occupy same level	0	2
Testes of same weight but lower on one side	1	8
Total	100	100

Table 3. *Mean weight and volume of right and left testes*

Age	N. (100)	Mean weight of testes (g.)		Mean volume of testes (c.c.)		Mean weight of testes with adnexa (g.)	
		Right	Left	Right	Left	Right	Left
10-19	1	12.90 ± 0	13.10 ± 0	12.50 ± 0	13.00 ± 0	17.90 ± 0	19.00 ± 0
20-29	3	12.44 ± 2.33	11.53 ± 1.64	12.20 ± 2.29	10.90 ± 1.35	20.05 ± 0.14	17.85 ± 0.14
30-39	25	10.89 ± 0.59	9.94 ± 0.64	10.64 ± 0.59	9.65 ± 0.64	17.58 ± 1.07	16.72 ± 1.16
40-49	37	9.95 ± 0.54	9.60 ± 0.48	9.63 ± 0.53	9.35 ± 0.47	16.24 ± 0.85	15.54 ± 0.76
50-59	18	9.57 ± 0.78	8.95 ± 0.62	9.40 ± 0.76	8.73 ± 0.59	15.51 ± 1.21	14.43 ± 1.03
60-69	10	8.81 ± 1.27	7.87 ± 1.17	8.58 ± 1.25	7.62 ± 1.16	17.57 ± 2.19	17.18 ± 2.12
70-79	6	7.32 ± 0.67	7.47 ± 1.20	7.05 ± 0.64	7.17 ± 1.20	14.57 ± 0.90	13.95 ± 1.17
Mean total		9.95 ± 0.33	9.36 ± 0.31	9.69 ± 0.33	9.10 ± 0.30	16.60 ± 0.52	15.81 ± 0.50
Mean difference		0.59 ± 0.09 ($P = < 0.001$)		0.59 ± 0.09 ($P = < 0.001$)		0.79 ± 0.26 ($P = < 0.01$)	

DISCUSSION

We consider the subjects reported herein a reasonably reliable sample, judging by the essentially similar results we obtained from all of the three groups, taken either separately or together. We are of the opinion that three conditions are requisite for obtaining reliable results, namely, unawareness of the purpose of the examination on the part of the subjects, warm and even temperature, and relaxation. We have purposely avoided the use of medical students as subjects because of the difficulty experienced in excluding psychological factors.

It has generally been taken for granted that the scrotum is asymmetrical with the left side occupying a lower level than the right. The finding among our series of 486 subjects shows instead an incidence of 10.5 % of scrota with the two sides

occupying the same level, 62.1% with the right side higher than the left and 27.4% showing the left side higher than the right. Furthermore, our data show the right side of the scrotum higher than the left in about 64.7% of right-handers, and nearly the reverse for left-handers, i.e. the left side higher than the right in 68%. These latter figures indicate clearly a correlation of scrotal asymmetry with handedness, which in itself may be considered as a conspicuous expression of a more general dynamic 'laterality' of the body. Perhaps the relative level of the two sides of the scrotum may prove to be a crude index to the 'laterality' of the trunk.

For our consideration of the scrotum from the angle of dynamic 'laterality', it may be helpful to free our thoughts from the trammel of embryological details and to look upon the scrotum simply as the lower paramedial parts of the ventral abdominal wall drooping down, i.e. the whole thickness of the ventral body wall 'dew-lapping' between the thighs, and to look upon the testis as extruded viscera and the saccus vaginalis as a lesser part of the general abdominal cavity isolated from the latter. The smooth musculature or the dartos of the scrotal skin is continuous with the peri-penile and peri-anal smooth musculature, all of which have spread out from the urogenital and anal triangles of the primitive perineum. The striated musculature of the scrotum is continuous with, in fact part and parcel of, the musculature of the ventral abdominal wall, but due to a functional modification the aponeurosis of the external oblique is here reduced to form the filmy external spermatic fascia, while the internal oblique mainly, and the transversus partly, form the cremaster whose function is to protect and sustain the underlying viscera in a manner comparable with the rest of the ventral abdominal muscles which overlie the viscera of the general abdominal cavity. The cremaster is known to draw the testes up for protection and it is interesting to mention in this connexion that one of the first lessons in Chinese methods of boxing is to train the cremaster to withdraw the testes from harm. Among other functions, the ventral abdominal muscles take part in postural reactions involving the flexion and rotation of the trunk as well as in the fixation of the ribs, sternum and pelvis in all the more vigorous movements of the limbs. The internal oblique of one side, which is continuous with the cremaster, flexes and rotates the trunk to the same side, an orientation which the body tends to assume as the hand approaches an object or a task. It is not unreasonable, therefore, to conjecture that the limb most employed, which is the right limb for most of us, tends to heighten the activities of the internal oblique and the cremaster of the same side.

The 30-35% of exceptions to our concept of correlation of scrotal level with handedness are important and they deserve careful study by electromyographic methods, such as used by Floyd & Silver (1950) in their study of the patterns of activity in the abdominal wall muscles in man. However, these discrepancies are to be expected for we are dealing with patterns of variable factors. Handedness in itself is an extremely complex trait; it can be strongly, mildly or weakly dominant; it can be mixed or covered. Also, posture of the body in greater or lesser measure must have its bearing on the activities of the internal oblique and cremaster both unilaterally and bilaterally.

Certain interesting facts emerge from an analysis of our data of testicular weight and its relation to position (Table 2), which would seem to shed some additional light

on the problem: (1) the χ^2 test shows that the right testis is generally heavier than the left ($P = < 0.001$). This would argue strongly against the thesis sometimes held that the left testis is usually lower than the right because of its heavier weight; (2) there would appear to be no association between testicular weight and position (higher or lower), according to the χ^2 test ($P = < 0.3$). It may be noted from Table 2 that of the right testes that are higher the majority are heavier, whereas with the left testes the reverse obtains. If weight is not a factor in influencing testicular position, then there must be some other factor or factors. It appears to us highly probable that the differential tonus or activity of the cremaster is an important factor.

If our concept of the cremaster as a contributory factor to scrotal asymmetry proves to be significant, it will be interesting to see what relationships it may have with certain other problems which concern the scrotum and testes. Cholst (1947) reported six cases of *situs inversus totalis*, all of whom had the right testis lower than the left. In fact, he considers this testicular position as typical of *situs inversus totalis*, his explanation being venous transposition. It is important, however, to know whether these cases also showed transposed functional 'laterality'. With regard to varicocele which happens generally on the left side, a weaker cremasteric tonus may be one of the predisposing factors aside from venous arrangement.

SUMMARY

The scrota of 486 subjects were examined. Exertion tests were applied which showed their effects on the position of the testis. The relative level of the two sides of the scrotum, without or with exertion, shows a correlation with handedness. The weight, volume and position of the testes were studied from 100 cadavers. It is shown that in the majority of cases the right testis is heavier than the left and that there seems to be no association between testicular weight and position.

Our sincere thanks are due to Professor Sir Wilfrid Le Gros Clark for his helpful suggestions. We would also like to express our thanks to Dr K. C. Tsang, Sister M. Aquinas, Dr A. R. Hodgson, Dr S. Bard, Dr Peter Wong, Dr Raymond Lee, Dr Doris Gray, Dr Arnold Hsieh, Rev. E. Kvan, Mr Brook Bernacchi and the staff of Hong Kong Sea School, Mr Lee Shing and Mrs Emily Hsieh for their kind assistance.

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